

# BioPlanta

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## Cleaner Production Potentials related to water and wastewater

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## Cleaner Production Potentials related to water and wastewater



**Industrial wastewater pollution**



**Analysis of water quality**



**Wastewater treatment**

## Key aspects of wastewater from food industry

- Food industry is one of the major water consuming industries
- Wastewater from food industry usually contains:
  - organic processing residues,
  - oil and grease,
  - nitrogen and phosphorous,
  - cleaning agents (both acidic and caustic),
  - high germ loads
- The wastewater is characterized by high COD and BOD<sub>5</sub>



## Consequences of discharge of polluted wastewater

### Direct discharge:

- Organic substances, nitrogen and phosphorous result in eutrophication, algal bloom and depletion of oxygen in receiving waters
- Pathogenic bacteria and viruses are increasing, health risk
- Drinking water resources are affected, e.g. by nitrate and nitrite immission into groundwater
- Disabling of further human utilisation
- Biodiversity is decreasing

### Indirect discharge:

- Overloading of sewage plants, which results in the above mentioned problems



## Scopes of efficient water and wastewater management

- Technical or organizational changes of production processes and/or production facilities to minimize environmental pollution
- Reduction of fresh water consume
- Minimization of wastewater amounts
- Reduction of wastewater pollution
- Application of sufficient wastewater treatment technologie
- Re-use of process water
- Cost saving effects



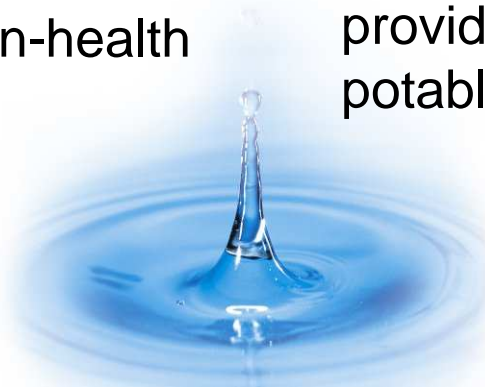
## Quality Requirements for re-use of process water

### Water that comes in contact with food products:

- potable water or equivalent quality
- the water for production must not contain any chemical substances in hazardous concentrations
- the water for production must not contain germs or only in non-health threatening levels

### Water for other processes:

- for process water, for example for heating and steam production, fire fighting, outside cleaning, vehicle cleaning and cooling, lower quality requirements are acceptable
- process water has to be stored and provided strictly separated from potable water



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**Analysis of water quality**



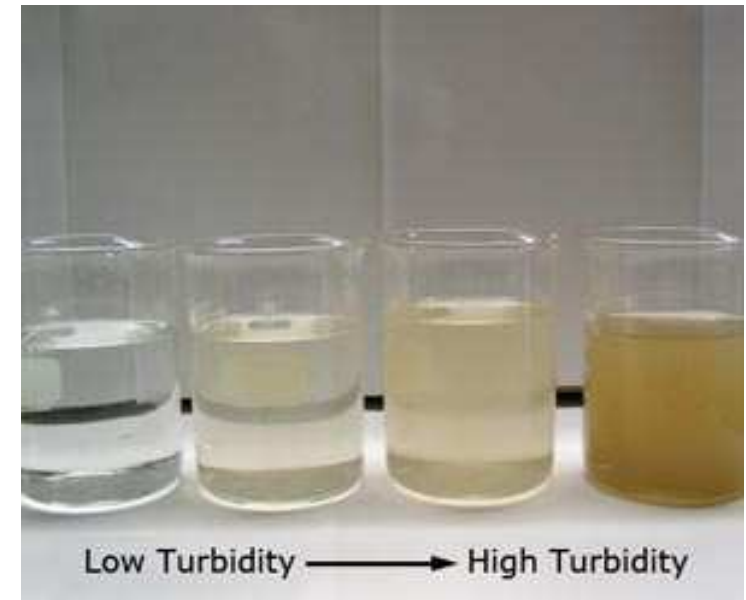
**Wastewater treatment**

## Constituents of wastewater from food industry

- Pathogens such as bacteria, viruses, worms;
- Organic particles such as feces, left overs from meat cutting, plant material, any other process residues;
- Soluble organic material such as urea, fruit sugars, soluble proteins, etc.;
- Grease and fat
- Inorganic particles such as sand, grit;
- Salts e.g. from preservation of meat;
- Toxins such as pesticides, herbicides;
- Cleaning and disinfecting agents

## Organoleptic parameters

- First easy indication of wastewater pollution
- **Turbidity** is caused by suspended matter (inorganic, organic particles, microbes)
- **Colored** water is a hint for pollution ! but it tells nothing about kind of pollution and colorless water can be polluted as well
- **Odor** is increased by anaerobic conditions in wastewater, foul smell can be caused by hydrogen sulphide ( $H_2S$ ) – toxic and corrosive
- **Foam** can be created by phosphate containing washing substances



## Total suspended solids

- weight of particles in a specific water amount (mg per litre)
- measured by a filter
- TSS in wastewater can be removed by sedimentation and filters



## Oxygen demand

### **BOD<sub>5</sub>**

- Measure for organic material in the water
- Biological breakdown of organic matter consumes O<sub>2</sub>
- analysis of how much oxygen is depleted (mg per litre) during five day period

### **COD**

- Measure for oxygen demand of all oxidizable pollutants in wastewater
- BOD<sub>5</sub> = 50 - 100% of COD: pollutants are well biodegradable
- BOD<sub>5</sub> < 50% of COD: pollutants are persistent or eco-toxic
- BOD<sub>5</sub> < 25% of COD: typical for wastewater after biological treatment

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## pH value

- measure of the acidity or alkalinity of an aqueous solution
- pH >7: can be consequence of caustic cleaning agents
- pH <7: can be consequence of acidic cleaning agents
- Goal for treatment of wastewater is pH 5-9 (tolerance level for most living organisms)



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## Cleaner Production Potentials related to water and wastewater



**Industrial wastewater pollution**



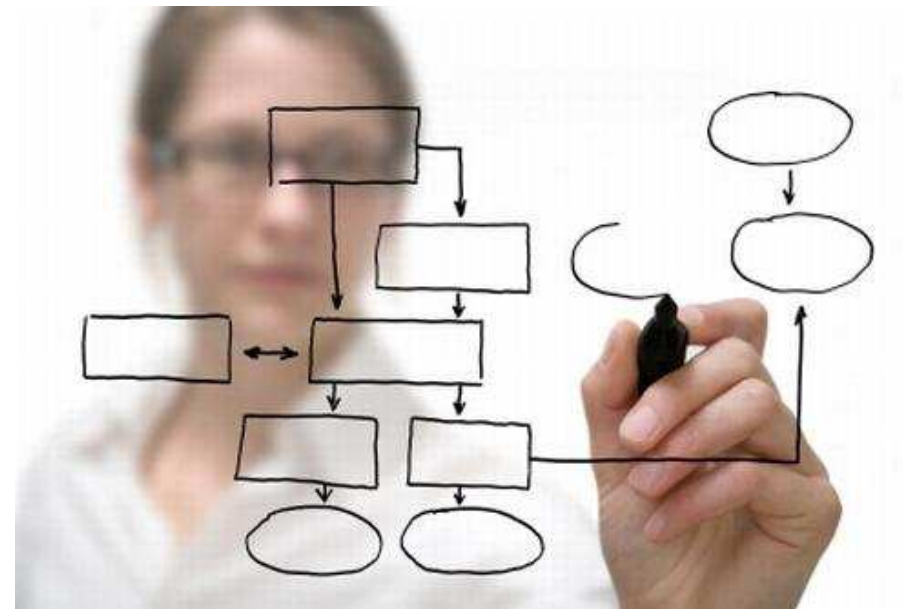
**Analysis of water quality**



**Wastewater treatment**

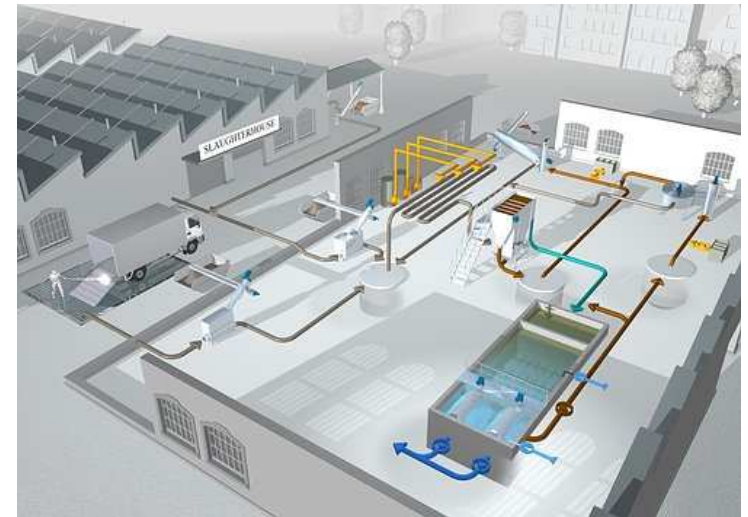
## Wastewater management

- Decrease of wastewater amounts and pollution (e.g. through less chemical use)
- Collection and treatment of polluted wastewater, separation and re-use of treatment residues
- Combination of wastewater treatment and energy management through production of biogas
- Recovery of substances in wastewater



## Treatment of industrial wastewater

- Industry requires flexible wastewater treatment plants due to changes of:
  - Products, raw materials and supplements
  - Production, storage and cleaning processes,
  - Production amounts
- Technical applications for treatment of industrial wastewater depend on:
  - Kind of pollutants, concentrations of pollutants
  - Treatment targets



## Technologies for treatment of organic polluted wastewater



### **SBR (Sequencing batch reactor)**

aeration, micro-biological treatment and sludge sedimentation



### **MBR (Membrane Bioreactor)**

combination of micro-filtration and activated sludge bioreactor



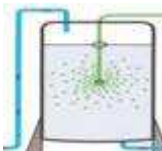
### **Ultra filtration**

use of pressure and polymer membranes with microscopic pores



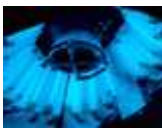
### **Reverse Osmosis**

use of high pressure to force water through a semi-permeable filter



### **Ozonisation**

disinfection by ozone



### **UV-irradiation**

disinfection by ultraviolet light

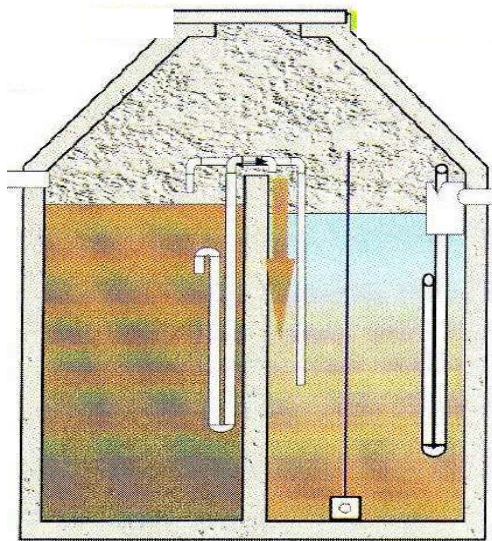
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- 1 [www.decker-wasser.de](http://www.decker-wasser.de)
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- 4 [www.archiexpo.com](http://www.archiexpo.com)
- 5 [www.samui-service.com](http://www.samui-service.com)
- 6 [www.green-livingblog.com](http://www.green-livingblog.com)

## Waste water treatment for internal water re-use Sequencing Batch Reactor or Membrane Bioreactor

### SBR technique

- high rates of contaminant reduction and increased flow rates in aerobic treatment step



Source: [www.goolge.de](http://www.goolge.de)

### Membrane Bioreactor (MBR)

- no post-treatment necessary
- water quality allows re-use in the production process



Source: [www.envirogen.com](http://www.envirogen.com)

## Waste water treatment for internal water re-use Membrane- or Ultra-filtration

combined biological  
treatment with **membrane-  
or ultra-filtration**

- better hygienization of wastewater
- preservation of biological active substances
- treated water re-usable for production process



Source: [www.goolge.de](http://www.goolge.de)

## Waste water treatment for internal water re-use Reverse Osmosis or Ozonisation

### Reverse Osmosis

- separation of dissolved substances, reduction of salt loads and COD
- high chemical water quality but no germ elimination, usable only as process water



Source: [www.Siemens.com](http://www.Siemens.com)

### Ozonisation

- disinfection of the treated water
- elimination of pathogenic germs
- depot effect
- high water quality



Source: [www.nais-rw.de](http://www.nais-rw.de)

## Waste water treatment for internal water re-use UV-irradiation or Constructed Wetlands

### UV-irradiation

- efficient disinfection
- no disturbance of color, taste and odor
- high water quality



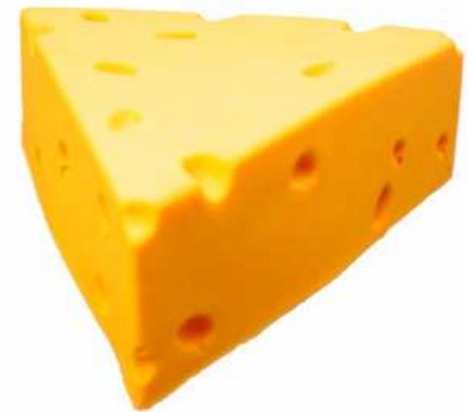
### Constructed Wetlands

- longer retention time, better treatment quality
- removal of organics and pathogenic germs
- considerable reduction of operating and maintenance costs



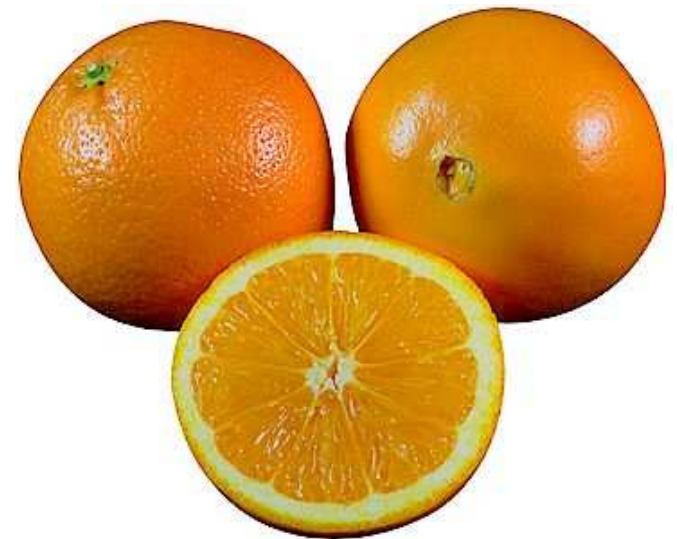
## Case study I: HUMANA Dairy plant, Altentreptow, Germany. Electricity from wastewater

- Conventional dairy plants with cheese production
- 2008 expansion of wastewater treatment necessary
- Wastewater from cheese and whey processing is highly polluted by organics
- Biogas is generated through anaerobic pre-treatment of wastewater
- Biogas is driving a combined heat and power plant (CHP) for electricity generation
- Waste heat is used for warm water



## Case study II: Wild Valencia, Carcaixent, Spain. Sugar free through modern process technology.

- The juice plant in the orange region Valencia is producing different fruit concentrates and flavors for juices and other food products
- Wastewater contains high sugar concentrations (energy source) is pre-treated anaerobically
- Main target is degradation of organic contents
- Positive co-effect is formation of biogas
- Biogas is used directly on-site



## Case study III: Teneria Europea, Leon, Mexico. Water recycling

### Initial situation:

- Tannery processing 1.000 skins per day, approx.: 80 - 100 m<sup>3</sup> wastewater
- Former treatment ineffective, treated wastewater contained high carbon and nutrient concentrations, environmental pollution
- High fresh water demand, high costs

### New after treatment:

- Higher quality of treated water, re-use as process water
- Reduction of fresh water demand and wastewater discharge



## Apalta Winery and Vineyards Viña Montes Water preservation.

Minimal amount of irrigation water in the vineyard:

- use of rainwater, harvested in the large water reservoirs
- use of computer controlled irrigation

Water recycling:

- Greywater, produced by production facilities is recycled
- returned to the environment as new irrigation water



**Muchas gracias por su atención!**

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